WE CLAIM:

1) Apparatus for the conversion of energy, comprising,

a) a source of energy for promoting electron tunneling, and,

b) an emitter electrode, connected to said source of energy, and,

c) a collector electrode, positioned sufficiently close to said emitter electrode for electrons to tunnel from the emitter electrode to the collector electrode, and,

d) electrical circuit means, connected to said electrodes, for the circulation of electrons, and,

d) manipulating means for controlling the relative electrode positioning, connected to one or both of said electrodes.

2) The apparatus of claim **1** further comprising housing means for said apparatus.

3) The apparatus of claim **2** wherein said housing means is thermally conductive.

4) The apparatus of claim **2** wherein said housing means further comprises flexible housing means for the enablement of the movement of said manipulating means and of said electrodes.

5) The apparatus of claim **2** further comprising thermally conductive metal powder connected to said collector electrode for the transferal of thermal energy.

6) The apparatus of claim **5** further comprising an extendable depository for said metal powder, for providing room for the metal powder as the collector electrode is moved to the area previously occupied by the metal powder.

7) The apparatus of claim **1** further comprising control means for assessing the electrode distance, and for actuating said manipulating means based on such assessment.

8) The apparatus of claim **1** wherein said manipulating means is selected from the group comprising piezo electric, electrostrictive, and magnetostrictive actuators.

9) The apparatus of claim **8** wherein said manipulating means comprises multiple actuators.

10) The apparatus of claim **9** comprising means for controlling said multiple actuators independently.

11) The apparatus of claim **8** wherein said manipulating means is for providing an initial relative electrode positioning of said electrodes.

12) The apparatus of claim **11**, wherein said manipulating means are not for providing ongoing relative electrode positioning of said electrodes.

13) The apparatus of claim **1**, for the conversion of thermal energy to electrical energy, wherein said source of energy is a source of thermal energy, and said emitter electrode

is thermally connected to a source of thermal energy, and wherein said apparatus further comprises heat sink means, thermally connected to said collector electrode, and an electrical load, electrically connected to said collector electrode.

14) The apparatus of claim **13** wherein said source of thermal energy is of solar origin, wherein solar heat is directed towards said emitter electrode.

15) The apparatus of claim **1**, for photoelectrical electricity generation, wherein said source of energy is a source of photons, directed at said emitter electrode for impacting the electrons in said emitter electrode and for causing said electrons to tunnel to said collector electrode, and wherein said apparatus further comprises an electrical load, electrically connected to said collector electrode, for receiving generated electricity.

16) The apparatus of claim **15** wherein said source of photons is also a source of thermal energy for providing said electrons in said emitter electrode with additional ability to tunnel to said collector electrode.

17) Apparatus for the conversion of electrical energy to heat pumping capacity, comprising the apparatus of claim **1**, wherein said source of energy comprises an electrical power supply, and further apparatus comprising a heat source and a heat sink, wherein said heat source may be cooler than

heat sink, and wherein said heat source is thermally connected to said emitter electrode and said heat sink is thermally connected to said collector electrode, and, means for applying a voltage bias to said electrodes for causing said emitter electrode to emit more electrons via thermotunnelling than the collector electrode emits, whereby heat pumping is enabled.

18) An electrical generator, comprising the apparatus of claim **1**, further comprising means for causing the oscillation of said manipulating means, for the production of alternating current.

19) A device for cooling, comprising

a) a diode, comprising an emitter and a collector electrode, and,

b) a substance from which heat is to be removed, and a substance to which heat is to be transferred, respectively thermally connected to said emitter and said collector electrodes, and

c) positioning means for spacially positioning at least one of said electrodes, relative to the other, and,

d) an electrical circuit between said emitter and collector, and,

e) means for providing a voltage bias to said emitter so that it transfers more heat to the collector than the collector transfers to the emitter.

20) The apparatus of claim **19** wherein said positioning

means are selected from the group consisting of piezoelectrical actuators, electrostrictive actuators, and magnetostrictive actuators.

21) The apparatus of claim **18** wherein the emitter and collector electrodes each have a surface that face each other, wherein said surfaces have topographically matching features.

22) The apparatus of claim **18** wherein said positioning means is positioned in the substantial middle of said collector electrode, and further comprising housing means for said emitter and collector, wherein said housing means comprises corrugated tubing in at least some areas, wherein said corrugated tubing is connected to said collector electrode to allow said collector to be moved by said positioning means in a longitudinal manner, whilst still being housed by said housing means.

23) A first and a second electrode for use in a diode device, each electrode having a surface for positioning facing the other electrode, wherein said surfaces are substantially flat and comprise matching topographical features to one another.

24) A diode device, selected from the group consisting of: thermionic Power Chips, thermionic Cool Chips, thermo-tunneling Power Chips, thermo-tunneling Cool Chips, photoelectric Power Chips, and Gap Diodes, comprising the first and second electrodes of claim **23**.

25) The diode device of claim **24** wherein said electrodes are positioned closer than 200 angstroms from one another.

26) The diode device of claim **25** wherein the electrodes are positioned 100 angstroms apart or closer, and wherein an inert gas fills the region between them.

27) The diode device of claim **24** further comprising manipulating means for controlling the spacing between said electrodes, wherein said manipulating means is selected from the group consisting of: electroactive, magnetostrictive, electrostrictive, and piezo-electric means.

28) The two electrodes of claim **23** in which the electrodes have differing thermal expansion coefficients.

29) The two electrodes of claim **28** wherein one electrode is for higher temperature operation than the other electrode, and said electrode for higher temperature operation has a lower thermal expansion coefficient than said other electrode.

30) The two electrodes of claim **29** wherein the ratio of said thermal expansion coefficients is greater than four to one.

31) The two electrodes of claim **29** wherein said electrode for higher temperature operation is composed of titanium.

32) The two electrodes of claim **29** wherein said other electrode is composed of aluminum.

33) A method for making the pair of electrodes of claim **23**, said method comprising the steps of:

a) fabricating a first electrode with a substantially flat surface,

b) coating said surface of said first electrode with a thin, uniform layer of a first material,

c) coating said layer of said first material with a layer of a second material suitable for use as a second electrode, and,

d) separating said first electrode and said first and second materials from one another, in a manner non-destructive to said first electrode and said second material, whereby said third material is suitable for use as a second electrode, and comprises matching topographical features to said first electrode.

34) The method of claim **33** further comprising the steps of:

a) positioning said electrodes less than 100 angstroms apart

b) adding an inert gas to the region between said electrodes to thermally insulate the electrodes from one another.

35) The method of claim **33** in which said first material is removed by a process selected from the group

consisting of: heating to a temperature greater than that of the melting temperature of said first material but lower than the melting temperature of said first electrode and of said second material, so as to evaporate said first material, introducing a solvent to dissolve said first material, introducing a reactive solution which reacts with said first material and dissolves it, and applying a vacuum to pump out any materials except said first electrode and said second material, or a combination of the above processes.

36) The method of claim **33** additionally comprising the steps of:

a) attaching said first electrode and said second material to controllable positioning means,

b) and using said controllable positioning means to effect a separation between said first electrode and said second material in the separating step

c) so that topographical features on the surface of said first electrode are maintained in spatial orientation with said matching topographical features on said second electrode.

37) A thermal insulator for thermally insulating two surfaces

from one another, comprising an inert gas enclosed in a gap of between 1 and 100 angstroms thickness between said two surfaces, and further comprising a manipulating means selected from the group consisting of electroactive, magnetostrictive, electrostrictive, and piezo-electric means, wherein the manipulating means is connected to one or both of said surfaces and is for controlling the distance of the surfaces from one another.

38) Apparatus for pumping heat, comprising

a) a diode, the emitter of said diode being in thermal contact with a mass from which heat is to be removed, a collector of said diode being in thermal contact with a mass to which heat is to be carried, and

b) a supply of electrical power for supplying current at a suitable voltage to said diode, wherein said emitter and collector are positioned close enough to one another to allow substantial electron tunneling from said emitter to said collector, and wherein there is a gap between said emitter and said collector.

39) The apparatus of claim **38** wherein said gap contains a vacuum.

40) The apparatus of claim **38** wherein said gap contains inert gas molecules.

41) A method for pumping heat, comprising:

a) a step of forming an emitter electrode

b) a step of forming a collector electrode

c) a step of connecting each electrode to electric power means and thermal transfer means

d) a step of bringing said electrodes to within 200 angstroms of each other, to allow electrons to tunnel between said electrodes

e) a step of applying a suitable voltage bias to said electrodes to pump heat from said emitter electrode to said collector electrode.

42) In a heat pumping system: emitter means having an emitter face; collector means having a collector face; housing means structured to hold said emitter and collector faces with close spacing between them; said close-spacing being no more than 200 angtroms distance to allow for electron thermotunneling from said emitter means to said collector means.